39 Cells Alive!

Now you know that all living organisms are made up of cells. Some are made of only a single cell. Others, such as people, onions, and elephants, are made of many cells. What do all these cells do?

Large multicellular organisms such as people take in oxygen. You use the oxygen to break down nutrients. This breakdown happens in the cells in organs all over your body. When your cells break down nutrients, wastes such as carbon dioxide are produced. In the picture on the left, the swimmer's lungs have taken in oxygen and are exhaling carbon dioxide. This oxygen is used to break down sugar from food in a process called **cellular respiration**. This process provides energy your body needs and releases carbon dioxide as waste.

How do we know that all these things happen in cells? In this activity, you will investigate yeast, another type of microorganism. Yeast is a single-celled organism. Using bromthymol blue (BTB) as the indicator, you will look for evidence that yeast cells respire. You may have used BTB in Activity 17, "Gas Exchange," when you investigated your own breath. Recall that BTB can be either blue or yellow. When there is carbon dioxide in a solution, BTB is yellow. Carbon dioxide is the main waste product of cellular respiration.

CHALLENGE

What do yeast cells have in common with human cells?

MATERIALS

For each group of four students

- 1 Chemplate® with gas delivery tube
- 1 dropper bottle of bromthymol blue (BTB) indicator
- 1 large plastic cup containing water
- ½ packet of sugar
- 2 droppers
- 2 stir sticks
- 1 magnifier
- 1 sheet of white paper
- 75 drops (approximately 3 mL) yeast suspension
- transparent tape (optional)

PROCEDURE

1. Have each person in your group of four choose one of the steps below and follow the instructions:

   a. Add 25 drops of yeast suspension to Cups 2, 3, and 4 of the Chemplate. Place this dropper near the yeast suspension. Do not use it for anything else.

   b. Add 2 drops of BTB indicator to the large oval cup of the Chemplate.

   c. Add 50 drops of water to the large oval cup of the Chemplate and stir with the BTB.

   d. Open the packet of sugar and carefully fill Cup 12 of the Chemplate with sugar. Give the rest of the sugar to another group of students.

2. Place the Chemplate on a sheet of white paper. Then use the small scoop on the end of the stir stick to add 10 scoops of sugar to the yeast suspension in Cup 3 and Cup 4.

3. Stir the sugar and yeast mixtures in Cup 3 and Cup 4.

4. Carefully observe the mixture in Cup 4 before capping it with the cup cover. Be sure that the cover fits tightly. (If not, use tape to secure it in place.)

5. Insert the tube extending off of the cup cover into the BTB solution (see Figure 1). If necessary, tape it into place.

Figure 1: Placement of the Cover and Tube

6. *Create a standard for comparison:* Place 1 drop of BTB and 25 drops of water in Cup 8.
7. Create a data table to record your initial and final observations of Cup 2, Cup 3, Cup 4, Cup 8, and the large oval cup. Be sure to list what is in each cup—for example, Cup 2 (yeast + water). Then record your initial observations of each cup, including the initial color of the solution in the large oval cup.
8. Based on your knowledge of BTB as an indicator, predict what will happen in the large oval cup. Record your prediction, making sure to explain why you think this will happen.
9. Follow your teacher's directions for observing the yeast cells through a microscope.
10. After 10–15 minutes, make observations about the liquid in the large oval cup. Then stir the solution and record its final color, making sure to compare it to the color of the standard in Cup 8.
11. Observe the mixtures in Cups 2, 3, and 4. Notice whether (and how) they have changed. Enter your observations in your data table.

ANALYSIS

1. Compare your experimental results to your prediction. Was your prediction correct? Explain.

2. Describe your results. Explain how your results do or do not provide evidence that yeast cells respire.

3. Think about the needs of multicellular organisms such as humans. What purpose did the sugar serve for the yeast?

4. **a.** What was the purpose of Cup 2?

   b. Imagine that you had more materials available to you. Design another control for this experiment.

5. Based on your observations of the yeast cells under the microscope, your investigation of the gas produced by the yeast cells, and the picture of yeast cells at high magnification in Figure 2, what do yeasts have in common with humans?